

REMARKS/ARGUMENTS

An embodiment of the present invention relates to “[A] method of purifying lithium sulfide wherein lithium sulfide obtained by reacting lithium hydroxide with hydrogen sulfide in an aprotic organic solvent is washed with an organic solvent at a temperature of 100°C or higher” as in Claim 1.

The rejection of Claims 1-4 and 14-17 under 35 U.S.C. 103(a) as being unpatentable over Japanese Patent 07-330312 by Koyama et al in view of US Patent No. 6,503,473 by Akiba is traversed.

Koyama discloses a manufacturing method of a lithium sulfide obtained by reacting lithium hydroxide and hydrogen sulfide in an aprotic organic solvent. Koyama further discloses washing the obtained lithium sulfide in NMP (N-Methyl-2-Pyrrolidone). However, as the Office recognizes, “[K]oyama is silent with regards to a washing temperature of 100 °C or higher” (see Office Action, page 3).

On the contrary, Applicants disclose the importance of the washing temperature of 100 °C or higher to further purify the lithium sulfide obtained by the reaction. In fact, Applicants further disclose that a lithium sulfide is purified, achieving a lithium N-methylaminobutyrate (LMAB) content of 0.1 % by weight or less when the lithium sulfide is washed with an organic solvent at a temperature of 100°C or higher as in Claim 4. Specifically, Applicants show that washing the lithium sulfide obtained by the reaction fails to achieve the lithium sulfide having the LMAB content of 0.1 % by weight or less when the washing temperature is below 100 °C even if the washing is carried out with a NMP solvent, e.g. when the washing temperature is 70 °C, a sample has a LMAB content of 4.60 wt% whereas the washing temperature is 105 °C, a sample has a LMAB content of 0.07 wt% (see specification, pages 11-14, Example 1 and Comp. Example 3). Thus, without the Applicant’s disclosure, one of ordinary skill in the art would not have foreseen the method as in Claim 1

to purify a lithium sulfide because Koyama does not disclose or suggest a washing temperature of 100°C or higher and furthermore does not even recognize the importance of the washing temperature to purify the lithium sulfide.

The secondary reference to Akiba does not cure the deficiencies of Koyama. Akiba discloses a process for separating a solid compound other than lithium hydroxide (see Akiba, Abstract and Claim 1). Akiba further discloses washing a crystal cake with an aprotic solvent to recover lithium hydrosulfide contained in the crystal cake at a temperature from 50 to 120 °C (see Akiba, Claim 1). However, the crystal cake of Akiba is not a lithium sulfide.

In detail, Akiba discloses as follows (see Akiba, Abstract, emphasis added):

A process for separating a solid compound other than lithium hydroxide, such as sodium chloride, in which lithium hydroxide is hydrosulfurized by bubbling gaseous hydrogen sulfide through an aprotic solvent, such as a polar organic compound, containing lithium hydroxide and the solid compound other than lithium hydroxide, solid-liquid separation is conducted under a condition in which the reaction of lithium hydrosulfide to lithium sulfide and hydrogen sulfide is suppressed and at a temperature of the liquid for separation at 50 to 150° C., and the separated crystal cake is further washed with the aprotic solvent to highly recover lithium hydrosulfide.

As disclosed above, Akiba discloses washing the separated crystal cake to recover lithium hydrosulfide but there is no disclosure or suggestion of washing a lithium sulfide. As to the separated crystal cake, the crystal cake is a resultant product obtained by **suppressing a reaction producing lithium sulfide** as disclosed above. Thus, in light of teachings by Akiba, the crystal cake should not contain lithium sulfide because the reaction to produce lithium sulfide is suppressed. Then, Akiba further discloses washing the crystal cake as follows (see Akiba, Col 5, lines 51-60):

Then, in the present invention, lithium hydrosulfide contained in a crystal cake is recovered by washing the separated crystal cake with an aprotic solvent. This is the washing step.

As disclosed above, Akiba does not disclose or suggest that: the crystal cake is lithium sulfide; washing the crystal cake is the same as washing a lithium sulfide; or washing the crystal cake purifies a lithium sulfide.

As the Office indicated, Akiba discloses in Comp. Example 2 that “[T]he crystal after washing was analyzed by a potentiometric titration method to confirm the presence of lithium sulfide” (see Akiba, Col. 9, lines 14-22). In detail, Akiba discloses that a wet cake was obtained by filtration of a mixture of lithium hydrosulfide in an amount of 85.5% and lithium sulfide of 14.5% and then the wet cake after the filtration was washed with a large amount of NMP at 100°C to obtain the crystal (see Akiba, Col. 9, lines 14-22). However, there is no literal disclosure that the wet cake after the filtration contained lithium sulfide prior to washing. Furthermore, even if the filtrated wet cake contained lithium sulfide, there is no suggestion that washing the filtrated wet cake at 100 °C purified the lithium sulfide contained in the filtrated wet cake and resulted in the crystal having a further purified lithium sulfide. Therefore, in light of teachings by Akiba, there would be no reason for one of ordinary skill in the art to combine Koyama and Akiba to purify a lithium sulfide by washing it with an organic solvent at a temperature of 100°C or higher.

Additionally, Akiba discloses washing a crystal cake at a temperature from 50 to 120 °C (see Akiba, Claim 1). However, Akiba fails to recognize the importance of the washing temperature of 100 °C or higher to achieve a lithium sulfide having a LMAB content of 0.1 % by weight or less as in Claim 4.

The Office appears to have combined the teachings of the references cited above in order to render the present invention obvious. In order to combine references to provide a

basis for rejecting a claim as obvious, those of ordinary skill in the art must have a reasonable expectation that the asserted combination will function successfully. However, the Office has not provided reasons that would have prompted one of ordinary skill in the art to combine Koyama and Akiba in the process according to the claimed invention. In this regard, the rejection over the combination of these references should be reconsidered and withdrawn.

The rejection of Claims 9-13 and 18 under 35 U.S.C. 103(a) as being unpatentable over Japanese Patent 07-330312 by Koyama et al in view of US Patent No. 6,503,473 by Akiba and as evidenced by US Patent No. 6,455,022 by Delmas.

Delmas discloses a process for the purification of an aqueous alkali metal chloride solution. Delmas further discloses filtration and decantation as the Office indicates (see Office Action, page 5). However, Delmas does not cure the deficiencies of Koyama and Akiba because Delmas does not disclose or suggest any of the limitations as in Claim 1. Furthermore, Delmas does not suggest any reasons to combine Koyama and Akiba. Therefore, there would be no motivation for one of ordinary skill in the art to combine Koyama, Akiba and Delmas to foresee the process as in Claim 1 and the dependent claims.

Withdrawal of the rejection is respectfully requested.

The rejection of Claims 5 and 7 under 35 U.S.C. 103(a) as being unpatentable over Japanese Patent 07-330312 by Koyama in view of US Patent No. 6,503,473 by Akiba as applied to Claims 1-4 and 9-16 and further in view of US Patent No. 6,022,640 by Takada et al.

Takada discloses a solid-state secondary lithium battery where an electrolyte can be synthesized from mainly of lithium sulfide as the Office indicates (see Office Action, page 6). However, Takada does not cure the deficiencies of Koyama and Akiba because Takada does not disclose or suggest washing a lithium sulfide with an organic solvent at a temperature of

100°C or higher as in Claim 1. Therefore, Koyama in combination with Akiba and Takada cannot render obvious Claim 1 and the dependent claims therefrom.

Withdrawal of the rejection is respectfully requested.

The rejection of Claims 6 and 8 under 35 U.S.C. 103(a) as being unpatentable over Japanese Patent 07-330312 by Koyama in view of US Patent No. 6,503,473 by Akiba as applied to Claims 1-4 and 9-16 and further in view of US Patent Pub. No. 2004/0109940 by Kugai et al.

Kugai discloses a method of producing a negative electrode for a lithium secondary cell. However, Kugai does not cure the deficiencies of Koyama and Akiba because Kugai does not disclose or suggest washing a lithium sulfide with an organic solvent at a temperature of 100°C or higher as in Claim 1. Therefore, Koyama in combination with Akiba and Kugai cannot render obvious Claim 1 and the dependent claims therefrom.

Withdrawal of the rejection is respectfully requested.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

Customer Number

22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/09)

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, L.L.P.
Norman F. Oblon



Soonwuk Cheong, Ph.D.
Registration No. 62,793